MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2022/2023 (2230)

PCH0016 – GENERAL CHEMISTRY

(Foundation in Engineering)

5 OCTOBER 2023
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages (excluding the front page) with 3 Questions in Section A and 3 Questions in Section B.

2. Attempt **all** questions. The distribution of marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

SECTION A: (14 MARKS)

Question 1

(a) Copy **Table AQ1a** below and supply the missing quantum numbers and the subshell names.

	n	l	m_l	**Subshell name**
(i)			-1	*4d*
(ii)	5		0	

Table AQ1a

[2 marks]

(b) Explain what is wrong with each of the statements below:

(i) Al_2O_3 is an example of an acidic oxide. [1.5 marks]

(ii) According to the modern Periodic Table, Silicon is an example of a nonmetal element in group 4A. [1.5 marks]

Question 2

(a) Give the name of the liquid properties responsible for the following scenarios:

(i) Beaded droplets on waxy surface. [1 mark]

(ii) In winter, motor oil flows slower compared to in summer. [1 mark]

(iii) Paper towels absorb water. [1 mark]

(b) Differentiate ionic crystal and metallic crystal in terms of

(i) the forces that are holding the units together. [1 mark]

(ii) their conductivity of heat and electricity. [1 mark]

Question 3

(a) Give the definition of acid and base according to Bronsted-Lowry concept. [2 marks]

(b) Which of the following is a stronger acid: $HClO_3$ or $HBrO_3$? Explain. [2 marks]

Continued...

SECTION B: (36 MARKS)

Question 1

(a) Given an element cobalt (Z=27).

(i) Draw the orbital diagram for cobalt without using a noble gas core. [1.5 marks]

(ii) State the number of unpaired electron that cobalt has. [0.5 mark]

(b) (i) Write a balanced chemical reaction equation for the reaction of chlorine gas with hydrogen gas. [1.5 marks]

(ii) Rank the following atoms in the order of increasing atomic radius (from smallest to largest):

Rb P F Mg [1.5 marks]

(c) Draw the Lewis structure (Lewis–dot symbol) for the following compounds:

(i) NO_2^- [2 marks]

(ii) K_2S [2 marks]

(d) Name the shape (molecular geometry) and give the AB_mE_n classification for the following compounds:

(i) OF_2 [2 marks]

(ii) PCl_3 [2 marks]

(e) For the following compound in **Figure BQ1e**:

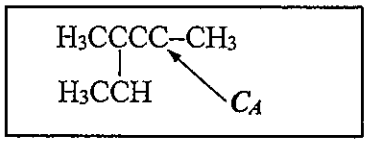

Figure BQ1e

(i) Predict the correct hybridization for the carbon atom, C_A, indicated in the molecule shown in **Figure BQ1e**. [1 mark]

(ii) Determine the number of sigma (σ) bonds and pi (π) bonds in the molecule. [1 mark]

Continued...

Question 2

(a) Draw two molecules of NH_3 and show the hydrogen-bonding among themselves. [2 marks]

(b) Below reaction is a first order reaction.

$$XY \longrightarrow X + Y$$

The half-life of the reaction is 45 seconds.

(i) Find the rate constant for this reaction. [1 mark]

(ii) Find the time required for 90% of XY to decompose. [2 marks]

(c) In a study, the following results shown in **Table BQ2c** are obtained for reaction:

$$A + B \rightarrow C + D$$

Table BQ2c

Experiment	$[A]_0$ (M)	$[B]_0$ (M)	Initial rate of reaction (M/s)
1	$4x$	y	r
2	$4x$	$2y$	$2r$
3	$2x$	$2y$	$2r$

Based on the information provided in **Table BQ2c**, determine

(i) the order of reaction with respect to A, [1.5 marks]

(ii) the order of reaction with respect to B, and [1.5 marks]

(iii) find the rate constant if $x = 0.8$, $y = 0.5$ and $r = 25$. [1 mark]

(d) Given the reaction:

$$\mathbf{A}\,(g) + 2\mathbf{B}(g) \rightleftharpoons \mathbf{C}(g) + 3\mathbf{D}\,(g)$$

Determine the direction of equilibrium shift if gas B is added to the system at equilibrium. [1 mark]

Continued...

Question 3

(a) Determine the concentration of OH^- ion at 25°C for each solution below and determine whether it is acidic, basic, or neutral.

(i) $[H^+] = 7.5 \times 10^{-5}$ M [1.5 marks]

(ii) $[H^+] = 1.0 \times 10^{-7}$ M [1.5 marks]

(b) A voltaic cell consists of a compartment with a zink bar immersed in a $Zn(NO_3)_2$ solution and another compartment with a copper bar immersed in a $Cu(NO_3)_2$ solution. A salt bridge of KNO_3 connects the two cells.

(i) State the anode and the cathode. [1 mark]

(ii) Write a balanced half-reaction at the anode. [1 mark]

(iii) Write a balanced half-reaction at the cathode. [1 mark]

(iv) Write the cell notation for this voltaic cell. [1 mark]

(c) A metal, X reacts with bromine to form XBr_3. Continuous electrolysis of XBr_3 by a steady current of 5.5 A for an hour deposits 4.0 g of the metal, X. Calculate the molar mass of the metal, X.
[Faraday constant = 96 500 C/mol e^-] [4 marks]

End of Paper